

SILURIAN CONODONTS FROM THE DIRK HARTOG FORMATION,
WESTERN AUSTRALIA

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Abstract

Conodont elements from the subsurface Dirk Hartog Formation, W.A., recovered by Glenister and Glenister (1957) are described and figured. The European ranges of these elements suggest a mid and late Ludlovian age for the upper part of the formation.

I. Introduction

The conodont elements described in this paper afforded the first record of Silurian conodonts in Australia (Glenister and Glenister 1957). They were recovered from the upper part of a carbonate unit intersected between depths of 2183 ft and 4608 ft in WAPET'S Dirk Hartog No. 17B test bore on Dirk Hartog Island, Western Australia (25°51'58"S., 113°04'40.5"E.). This unit was named the Dirk Hartog Limestone by McWhae *et al.* (1958, p. 31).

Glenister and Glenister (*op. cit.*) reviewed the age of this conodont fauna, together with that of fragmentary megafossils recovered from the core, and concluded that a mid Silurian (Niagaran) age was indicated. Subsequently, Öpik (1959, p. 14) suggested 'that the upper part of the Limestone may extend into the Devonian'. The generally unsatisfactory status of the Lower Palaeozoic subsurface units of the Carnarvon Basin and their doubtful correlation has recently been discussed by Condon (1965).

When these conodont elements were discovered it was not possible for them to provide other than a broad indication of age. Over the last decade, however, knowledge of Silurian conodont faunas has been substantially increased. In particular, Walliser (1962, 1964) has recognized a zonal succession of faunas in the Silurian of Europe, which may also be applied in the Silurian of N. America (Rexroad and Rickard 1965). The conodonts from the Dirk Hartog Limestone may also be referred to Walliser's scheme.

I am obliged to Professor B. F. Glenister, of the State University of Iowa, who passed on the conodont collection for description, and to Mrs B. Pearson, who made the conodont illustrations in Fig. 1. West Australian Petroleum Pty. Limited (WAPET) contributed generously in supporting the publication of this article.

II. Composition of the Fauna

Conodonts were recovered from seven stratigraphic intervals through the formation. These are:

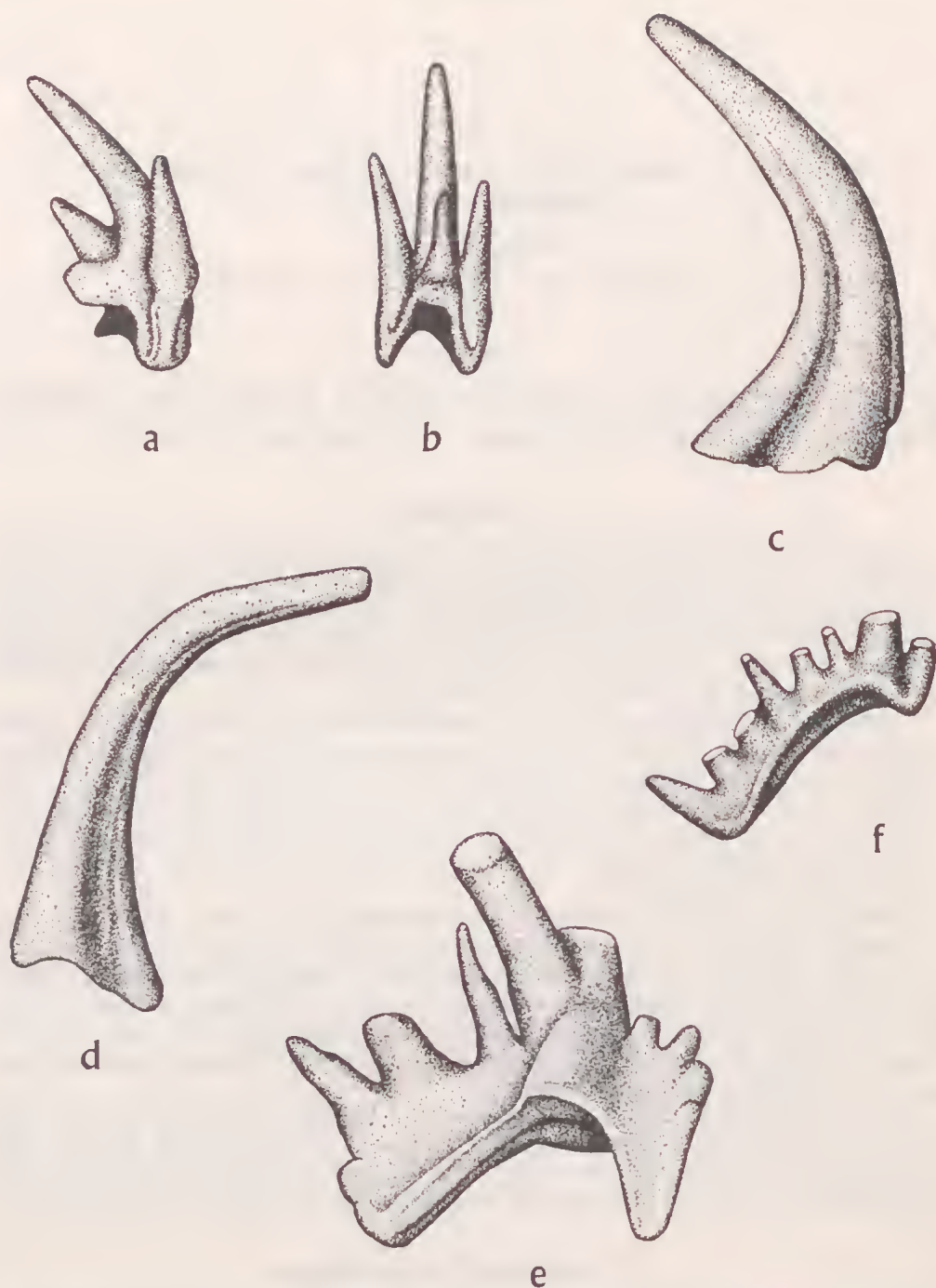


FIG. 1—(a), (b) Lateral and posterior views of *Hibbardella* sp. (c) *Panderodus simplex* (Branson & Mehl); lateral view of 59824. (d) *Panderodus unicostatus* (Branson & Mehl); lateral view of 59820. (e) *Lonchodina greilingi* Walliser; oblique inner view of specimen with double cusp (59812). (f) *Neoprioniodus latidentatus* Walliser; inner lateral view of 59805. Figures $\times 60$ approximately.

Core	Stratigraphic Intervals	Samples
6	2180 ft-2198 ft	7
7	2300 „-2305 „	6
8	2345 „-2360 „	5
12	2687 „-2701 „	4
13	2722 „-2740 „	3
14	2900 „-2910 „	2
19	3522 „-3538 „	1

Hereafter these intervals will be referred to by their sample numbers.

In all there are approximately 200 identifiable conodonts in the collection. Their distribution in the samples is given in Table 1.

Worthy of particular note in the fauna is the number of specimens which exhibit regeneration. The occurrence of this in conodont elements has been discussed previously by Hass (1941), Rhodes (1954) and Lindström (1964). In previously reported examples, the regenerated distal portion of a denticle has a smaller diameter, and the new growth axis may be offset from that of the original denticle. The broken-off portion of the denticle was apparently lost. Rhodes (1954) maintained that this suggests that the elements were exposed in the conodont animal. Lindström (1964), on the other hand, suggested that the broken parts were either expelled from the body of the animal, or were resorbed.

TABLE 1
Distribution of conodont species through the Dirk Hartog Formation

	1	2	3	4	5	6	7
<i>Hibbardella</i> sp.							+
<i>Ligonodina silurica</i> Branson & Mehl				+	?		
<i>Ligonodina</i> sp.				+			
<i>Ligonodina</i> sp. indet.		+				+	
<i>Lonchodina greilingi</i> Walliser				+	+	+	+
<i>Lonchodina walliseri</i> Ziegler				+			
<i>Neoprioniodus bicurvatus</i> (Branson & Mehl)							+
<i>Neoprioniodus latidentatus</i> Walliser	+					+	+
<i>Ozarkodina</i> sp. affin. <i>fundamentata</i> (Walliser)		?		+			
<i>Ozarkodina jaegeri</i> Walliser							+
<i>Ozarkodina ziegleri tenuiramae</i> Walliser				+	+		
<i>Ozarkodina</i> sp. indet.							+
<i>Panderodus simplex</i> (Branson & Mehl)				+	+	+	
<i>Panderodus unicostatus</i> (Branson & Mehl)				+		+	
<i>Panderodus</i> sp.				+			
<i>Plectospathodus</i> sp.				+			+
<i>Spathognathodus primus</i> (Branson & Mehl)							+
<i>Trichonodella inconstans</i> Walliser				+	?		
<i>Trichonodella symmetrica</i> (Branson & Mehl)				+			
Gen. et sp. indet.	+	+	+	+	+	+	

The specimen of *Lonchodina greilingi* illustrated in Pl. 17, fig. 21 and Fig. 1e is of particular interest. This specimen has a double cusp. The inner eusp is slender and is directed inwards and sideways; the outer eusp is more robust and is more normally directed. The base of the inner eusp is marked by a line of clear material.

It would appear that the specimen represents a conodont element in which the cusp was cracked and so ceased to grow. A new cusp (now represented by the outer, thicker cusp) then developed. The denticles of one of the lateral limbs also show normal regeneration. The specimen would therefore seem to suggest that

resorption by the conodont animal of broken pieces of element did not always take place.

III. Age of the Fauna

The bar elements of the fauna provide a clear indication of age in relation to the ranges given by Walliser (1964). Table 2 summarizes the ranges of various species common to the Dirk Hartog Limestone and Europe. Most of these are long ranging Ludlovian species which extend upward into the Lower Devonian. It will be seen, however, that the occurrence of *Ozarkodina ziegleri tenuiramae* and *Ozarkodina* affin. *fundamentata* suggests a broad correlation with the mid Ludlovian *ploekensis* Zone (approximating to the zone of *Monograptus chimaera*). Sample 7, from the top of the formation, contains *Ozarkodina jaegeri* and *Neoprioniodus bicurvatus* which indicate a late Ludlovian age in terms of European occurrences. The absence of representatives of the ubiquitous *Spathognathodus steinhornensis* group in this upper sample would seem to preclude a latest Ludlovian or Devonian age.

The Dirk Hartog Formation, as intersected in the No. 17B test bore, is 2,425 ft thick. The European ranges of conodonts recovered from the top 500 ft of the formation, suggest a mid to late Ludlovian age for this interval. The occurrence of the pentamerid brachiopod *Conchidium* (A. A. Opik in Glenister and Glenister 1957) at a depth of approximately 1,500 ft beneath top of the formation, indicates that at least the uppermost three-fifths of the formation is of Ludlovian age.

In the absence of platformed elements, however, it would be unwise to assign more than a broad Ludlovian age to the Dirk Hartog conodont fauna. Elements in the fauna, such as *Neoprioniodus bicurvatus* (Branson & Mehl), *Spathognathodus primus* (Branson and Mehl), and *Trichonodella symmetrica* (Branson and Mehl), which in Europe appear first in the late Ludlovian (Walliser 1964), were originally described from the Bainbridge Formation of Missouri. Generally this unit is not considered to be younger than early Ludlovian. Indeed, Rexroad's (1967) recent study of Llandoveryan conodonts of the Brassfield Formation suggests that similar or identical bar elements are much more long-ranging than is indicated by European occurrences.

IV. Systematics

All specimens are registered in the Palaeontological Collection of the University of Western Australia. The synonymies refer only to primary references and Australian occurrences.

Genus *Hibbardella* Bassler 1925

TYPE SPECIES: *Prioniodus angulata* Hinde 1879.

REMARKS: The confusion which exists in the generic classification of conodont elements which comprise a symmetrical anterior arch with a denticulated posterior bar has been reviewed elsewhere (Philip 1967). After restudy of the type specimen of *Prioniodus angulata* it was concluded that *Hibbardella* should be employed for such forms with a large basal cavity.

Hibbardella sp.

(Fig. 1a-b)

DESCRIPTION: Cusp circular in cross section and recurved posteriorly over the posterior bar. Anterior arch U-shaped, and bearing an upright denticle on each side of the cusp. Posterior bar short with a single, backwardly directed denticle. Basal cavity deeply excavated and continued beneath the posterior bar and the lateral limbs.

REMARKS: The other common Silurian species *Ligonodina salopia* Rhodes (1953, p. 307; Pl. 23, fig. 245, 257, 260) has a much longer lateral process which is more anteriorly directed. Recently Rexroad (1967, p. 35) has suggested that this species may be a synonym of the poorly known species *Ligonodina kentuckyensis* Branson & Branson (1947, p. 555; Pl. 82, fig. 28, 35).

A number of very fragmentary specimens in the collection, clearly referable to *Ligonodina*, cannot be identified specifically. In Table 1 they are listed as *Ligonodina* sp. indet.

***Ligonodina* sp.**

(Pl. 18, fig. 4, 7-8)

REMARKS: Several small, delicate specimens in the collection appear to differ from *L. silurica* in that their lateral process is more anteriorly directed and that the posterior limb is shorter and is straight. Conceivably they could represent immature specimens of this species.

FIGURED SPECIMENS: 59796-59798.

Genus *Lonchodina* Bassler 1925

TYPE SPECIES: *Lonchodina typicalis* Bassler 1925.

***Lonchodina greilingi* Walliser**

(Fig. 1e; Pl. 17, fig. 17-18, 21)

Lonchodina greilingi Walliser 1957, p. 38; Pl. 3, fig. 20-26; Walliser, 1964, p. 44; Pl. 8, fig. 7; Pl. 30, fig. 7-8 (*cum synon.*); Philip 1965, p. 104; Pl. 9, fig. 22.

DIAGNOSIS: *Fide* Philip 1965, *loc. cit.*

FIGURED SPECIMENS: 59810-2.

REMARKS: The remarkable regeneration of the cusp, seen in the specimen of this species illustrated in Pl. 17, fig. 21, is discussed in II. Composition of Fauna (above).

***Lonchodina walliseri* Ziegler**

(Pl. 17, fig. 19)

Lonchodina walliseri Ziegler 1960, p. 188; Pl. 14, fig. 1, 3, 7; Walliser 1964, p. 44-45; Pl. 8, fig. 17; Pl. 30, fig. 26-33; Philip 1965, p. 104; Pl. 8, fig. 35.

DIAGNOSIS: *Fide* Philip 1965, *loc. cit.*

FIGURED SPECIMEN: 59813.

Genus *Neoprioniodus* Rhodes & Müller 1956

TYPE SPECIES: *Prioniodus conjunctus* Gunnell 1933.

***Neoprioniodus bicurvatus* (Branson & Mehl)**

(Pl. 17, fig. 15)

Prioniodus bicurvatus Branson & Mehl 1933, p. 44; Pl. 3, fig. 9-12.

Neoprioniodus bicurvatus (Branson & Mehl) Walliser 1964, p. 46; Pl. 9, fig. 13; Pl. 29, fig. 27-33; Fig. 5d (*cum synon.*); Philip 1965, p. 105; Pl. 9, fig. 13, 18, 20; Philip 1966, p. 446; Pl. 3, fig. 12-16.

DIAGNOSIS: *Fide* Philip 1966, *loc. cit.*

FIGURED SPECIMEN: 59789.

Neoprioniodus latidentatus Walliser

(Fig. 1f; Pl. 17, fig. 7-11, 16)

Prioniodina excavata (Branson & Mehl) Walliser 1957, p. 46; Pl. 2, fig. 17; Ziegler 1960, p. 192; Pl. 15, fig. 5.*Neoprioniodus latidentatus* Walliser 1964, p. 50; Pl. 8, fig. 15; Pl. 29, fig. 34-35, fig. 5b.*Neoprioniodus* (?) sp. Philip 1965, p. 105; Pl. 9, fig. 14.non *Prioniodus excavatus* Branson & Mehl 1933, p. 45; Pl. 3, fig. 7-8.

DIAGNOSIS: A species of *Neoprioniodus* with widely spaced, rounded denticles, and a large basal cavity which is continued as a flat distally tapering groove beneath the posterior limb.

FIGURED SPECIMENS: 59803-59808.

REMARKS: Although the denticulation and the basal cavity of the Dirk Hartog specimens are characteristic of this species, none of the Silurian material described and figured by Walliser (1957, 1964) has the well developed 'anticusp' or anterior limb with discrete denticles seen in the specimens here illustrated. However, Walliser (1964) included in this species the Gedinnian form illustrated by Ziegler (*loc. cit.*) which shows this feature. Furthermore, the Dirk Hartog material indicates that specimens lacking an anticusp may intergrade with forms in which it is well developed. Accordingly, the specimen described by Philip (*loc. cit.*) from the early Devonian of Victoria should be referred to this species. It should be noted that in the smallest available specimens (particularly that illustrated in Pl. 17, fig. 8) the denticles are closely spaced and the basal cavity is relatively smaller.

'*Euprioniodina* cf. *Prioniodus excavata* Branson & Mehl' of Rexroad (1967, p. 31-32; Pl. 3, fig. 7-8) from the Llandoveryan of the Cincinnati Arch region is almost identical with the Dirk Hartog material, but differs in the more horizontal, shorter posterior limb. Because of the well defined anterior limb with discrete denticles, Rexroad refers his form to *Euprioniodina*.

Large specimens of *N. latidentatus* in the fauna may resemble *Lonchodina greilingi* (cf. Pl. 17, fig. 16, 18). However, in this latter species the basal cavity continues beneath both of the twisted limbs which tend to be of similar length.

Genus Ozarkodina Branson & Mehl 1933

TYPE SPECIES: *Ozarkodina typica* Branson & Mehl 1933.

Ozarkodina fundamentata (Walliser)

Spathognathodus fundamentatus Walliser 1957, p. 48; Pl. 1, fig. 11-14; Walliser 1965, p. 56-57; Pl. 7, fig. 18; Pl. 23, fig. 5-14, fig. 3d, e. (*cum synonym.*).

Ozarkodina sp. affin. **O. fundamentata** (Walliser)

(Pl. 18, fig. 1, 6, 11, 13, 17, 21-22)

DESCRIPTION: A bladed, gently arched unit, usually with regular denticles which become progressively inclined toward the posterior end. A denticle toward the posterior end, usually above the basal cavity, is enlarged to give a poorly defined cusp. Basal cavity usually centrally located and continued beneath the posterior limb as a shallow groove; lateral lobes present but not prominent.

FIGURED SPECIMENS: 59774-59780.

REMARKS: Although this element has the general morphology of *O. fundamentata*, it lies outside the range of variation ascribed to the species by Walliser (1964). The Dirk Hartog specimens possess fewer denticles, the posterior limb is not strongly deflected downwards and the basal cavity is more centrally located and has more subdued lateral lobes.

Ozarkodina jaegeri Walliser

(Pl. 17, fig. 20)

Ozarkodina jaegeri Walliser 1964, p. 57-58; Pl. 9, fig. 16; Pl. 25, fig. 11-18, Fig. 3n-o.

DIAGNOSIS: A bladed species of *Ozarkodina* with regularly developed denticles. Anterior limb higher than posterior limb which tends to taper posteriorly. Cusp well defined and centrally located; basal cavity confined to the central part of the unit, usually with small projecting lips.

FIGURED SPECIMEN: 59814.

Ozarkodina ziegleri Walliser

DIAGNOSIS: An arched species of *Ozarkodina* with somewhat twisted and incurved limbs, the posterior one of which is the lower. Cusp and denticles well developed and also tending to be incurved.

Ozarkodina ziegleri tenuiramae Walliser

(Pl. 18, fig. 5, 10, 16, 20, 26-28)

Ozarkodina ziegleri tenuiramae Walliser 1964, p. 62-63; Pl. 3, fig. 15; Pl. 24, fig. 22-28, Fig. 3g-h.

DIAGNOSIS: A subspecies of *Ozarkodina ziegleri* with relatively low limbs and wide basal cavity which extends as a very flat groove to the posterior end of the unit.

FIGURED SPECIMENS: 59782-59788.

REMARKS: As the available material forms a graded growth series, all specimens are referred to the one subspecies of *O. ziegleri*. It should be noted, however, that in the smaller specimens the basal cavity is not continued to the posterior end of the unit.

Ozarkodina sp. indet.

(Pl. 17, fig. 23)

DESCRIPTION: A very flattened bladed unit with a high anterior bar, the denticles of which become progressively higher toward the backwardly directed cusp. Posterior limb low; basal cavity a tiny depression beneath the cusp.

FIGURED SPECIMEN: 59815.

REMARKS: This single small specimen with an incomplete posterior bar cannot be positively identified. In its general form it resembles most closely *Ozarkodina edithae* Walliser (1964, p. 55-56; Pl. 26, fig. 12-18) but it could rather be an immature specimen of the *Ozarkodina typica* group.

Genus Panderodus Ethington 1959

TYPE SPECIES: *Paltodus unicostatus* Branson & Mehl 1933.

Panderodus simplex (Branson & Mehl)

(Fig. 1c; Pl. 17, fig. 2, 3, 5, 12)

Paltodus simplex Branson & Mehl 1933, p. 42; Pl. 3, fig. 4.

Panderodus simplex (Branson & Mehl), Clark & Ethington 1966, p. 682; Pl. 82, fig. 10, 14 (cum synon.).

Paltodus acostatus Branson & Branson 1947, p. 554; Pl. 82, fig. 1-5, 23-24.

Panderodus acostatus (Branson & Branson), Philip 1965, p. 108; Pl. 8, fig. 10, 23, 43; Fig. 2h-i. Philip 1966, p. 447; Pl. 1, fig. 13, 18.

DIAGNOSIS: *Fide* Philip, *loc. cit.*

FIGURED SPECIMENS: 59822-59825.

Panderodus unicostatus (Branson & Mehl)

(Fig. 1d; Pl. 17, fig. 1, 4, 13-14)

Paltodus unicostatus Branson & Mehl 1933, p. 42; Pl. 3, fig. 3; Philip 1965, p. 109; Pl. 8, figs. 9; Fig. 2g.*Panderodus unicostatus* (Branson & Mehl), Clark & Ethington 1966, p. 683; Pl. 82, fig. 17, 19 (*cum synonym.*); Philip 1966, p. 447; Pl. 1, fig. 10-12, 19.DIAGNOSIS: *Fide Philip loc. cit.*

FIGURED SPECIMENS: 59818-59821.

Panderodus sp.

REMARKS: A single specimen, apparently referable to *Panderodus*, differs from others in the fauna in the broadly triangular cross section of its shallow basal cavity. Carinae are developed at the margins of the flattened anterior face. The specimen resembles most closely *Paltodus dyscritus* Rexroad (1967, pp. 42-44; Pl. 4, fig. 30, 34).

FIGURED SPECIMEN: 59809.

Genus **Spathognathodus** Branson & Mehl 1941TYPE SPECIES: *Ctenognathus murchinsoni* Pander 1856**Spathognathodus primus** (Branson & Mehl)

(Pl. 17, fig. 22, 24)

Spathodus primus Branson & Mehl 1933, p. 46; Pl. 3, fig. 25-30.*Spathognathodus primus* (Branson & Mehl) Walliser 1964, p. 80-82; Pl. 8, fig. 14; Pl. 22, fig. 9-25; Pl. 23, fig. 1-4, fig. 8. (*cum synonym.*)

DIAGNOSIS: A heavily constructed species of *Spathognathodus*, usually with well defined, somewhat irregular denticles, which tend to be lower at the posterior end of the unit. Lateral lobes small and thickened and usually centrally located.

FIGURED SPECIMENS: 59816-59817.

REMARKS: The extreme variation seen in this species has been described by Walliser (*loc. cit.*). The Dirk Hartog specimens appear to conform most closely to Walliser's *latialatus* Zone forms rather than younger forms. They also closely resemble Branson & Mehl's original material from the Bainbridge Formation of Missouri.

Genus **Trichonodella** Branson & Mehl 1948TYPE SPECIES: *Trichognathus prima* Branson & Mehl 1933.**Trichonodella inconstans** Walliser

(Pl. 18, fig. 9, 12, 14-15)

Trichonodella inconstans Walliser 1957, p. 50; Pl. 3, fig. 10-17; Walliser 1964, p. 90; Pl. 30, fig. 10-12 (*cum synonym.*); Philip 1965, p. 112; Pl. 9, fig. 15, 25; Philip 1966, p. 451; Pl. 3, fig. 23; Pl. 4, fig. 21, 23, 27, 30.DIAGNOSIS: *Fide Philip 1966, loc. cit.*

FIGURED SPECIMENS: 59792-59795.

Trichonodella symmetrica (Branson & Mehl)

(Pl. 18, fig. 24)

Trichognathus symmetrica Branson & Mehl 1933, p. 50; Pl. 3, fig. 33-34.*Trichonodella symmetrica* (Branson & Mehl) Walliser 1964, p. 90; Pl. 9, fig. 11; Pl. 31, fig. 28-30; Philip 1965, p. 112-113; Pl. 9, fig. 19, 21 (*cum synonym.*).DIAGNOSIS: *Fide Philip 1965, loc. cit.*

FIGURED SPECIMEN: 59781.

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Explanation of Plates

All figures $\times 40$

PLATE 17

- Fig. 1, 4, 13-14—*Panderodus unicostatus* (Branson & Mehl). (1) 59818; (4) 59819; (13) 59820; (14) 59821. Specimens from Sample 4.
- Fig. 2, 3, 5, 12—*Panderodus simplex* (Branson & Mehl). (2) 59822; (3) 59823; (5) 59824; (12) 59825. Specimens from Sample 4.
- Fig. 6—*Panderodus* sp. 59809, Sample 7.
- Fig. 7-11, 16—*Neoprioniodus latidentatus* Walliser. (7) Inner lateral view of 59803; (8) Inner lateral view of 59804; (9) Inner lateral view of 59805; (10) Inner lateral view of 59806; (11) Inner lateral view of 59807; (16) Inner lateral view of 59808. Specimen from Sample 4.
- Fig. 15—*Neoprioniodus bicurvatus* (Branson & Mehl). Inner lateral view of 59789, Sample 7.
- Fig. 17-18, 21—*Lonchodina greilingi* Walliser. (17) Inner view of 59810; (18) Inner lateral view of 59811; (21) Inner lateral view of 59812, specimen with a double cusp. Specimens from Sample 4.
- Fig. 19—*Lonchodina walliseri* Ziegler. Lateral view of 59813, Sample 7.
- Fig. 20—*Ozarkodina jaegeri* Walliser. Lateral view of 59814, Sample 7.
- Fig. 22, 24—*Spathognathodus primus* (Branson & Mehl). (22) Lateral view of 59816; (24) Lateral view of 59817, Sample 4.
- Fig. 23—*Ozarkodina* sp. Lateral view of 59815, Sample 7.

PLATE 18

- Fig. 1, 6, 11, 13, 17, 21-22—*Ozarkodina* sp. affin. *O. fundamentata* (Walliser). (1) 59774; (6) 59775; (11) 59776; (13) 59777; (17) 59778; (21) 59779; (22) 59780. Lateral views of specimens from Sample 4.
- Fig. 2-3—*Plectospathodus* sp. (2) Inner lateral view of 59790; (3) Inner lateral view of 59791. Specimens from Sample 4.
- Fig. 4, 7-8—*Ligonodina* sp. (4) Inner view of 59796; (7) Inner view of 59797; (8) Inner view of 59798. Specimens from Sample 4.
- Fig. 5, 10, 16, 20, 26-28—*Ozarkodina ziegleri tenuiramae* Walliser. (5) 59782; (10) 59783; (16) 59784; (20) 59785; (26) 59786; (27) 59787; (28) 59788. Lateral views of specimens from Sample 4.
- Fig. 9, 12, 14-15—*Trichonodella inconstans* Walliser. (9) Oblique posterior view of 59792, showing basal cavity; (12) Posterior view of 59793; (14) Posterior view of 59794; (15) Posterior view of 59795. Specimen from Sample 4.
- Fig. 18-19, 23, 25—*Ligonodina silurica* Branson & Mehl. (18) 59799; (19) 59800; (23) 59801; (25) 59802. Inner lateral views of fragmentary specimens from Sample 4.
- Fig. 24—*Trichonodella symmetrica* (Branson & Mehl). Inner view of 59781, Sample 4.
- FIG. 1—(a), (b) Lateral and posterior views of *Hibbardella* sp. (c) *Panderodus simplex* (Branson & Mehl); lateral view of 59824. (d) *Panderodus unicostatus* (Branson & Mehl); lateral view of 59820. (e) *Lonchodina greilingi* Walliser; oblique inner view of specimen with double cusp (59812). (f) *Neoprioniodus latidentatus* Walliser; inner lateral view of 59805. Figs. $\times 60$ approximately.